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DEPARTMENT OF ECOLOGY

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MEMORANDUM
December 23, 1982

To: Frank Monahan/Ken Mauermann

From: Bill Yake BY

Subject: Reconnaissance and Sampling Survey; Sumner STP and Nabisco Brands - November 18, 1982

Introduction and Background

Since approximately August, 1981, the Sumner STP has experienced difficulty in meeting effluent limitations for suspended solids (SS) and (to a lesser extent) biochemical oxygen demand (BOD). The precise reasons for the problems at the Sumner STP are not clear, but operating personnel at the treatment plant believe that effluent non-compliance is directly linked to industrial wastewaters discharged to the STP from Nabisco Brands, Inc. (formerly Standard Brands), a yeast manufacturing plant.

Although wastewaters have been discharged from the yeast plant to the STP for many years, changes have occurred in the type of wastes and degree of pretreatment provided to wastewaters prior to discharge to Sumner STP. The first important change occurred in June, 1978, when a substantial portion of the wastewaters (including MYCES condensate) was routed to land application. The land application system generally functioned from March through the first half of November, with all wastewaters being sent to Sumner during the winter. In June, 1981, an aerated lagoon with a nominal detention time of four days began pretreating wastes from the yeast plant prior to discharge to the Sumner STP. This lagoon was designed to equalize discharge wasteloads and decrease the overall BOD load of yeast plant wastes going to the Sumner STP. As noted in Figure 1, the lagoon did result in a general decrease in yeast plant effluent BOD. This was, however, accompanied by an increase in suspended solids.

In approximately July of 1981, land application was discontinued and these wastewaters (including the MYCES condensate) were rerouted to the lagoon.

Between September, 1981, and January, 1982, (three to eight months after lagoon startup) effluent quality at the Sumner STP began to deteriorate. Figure 2 illustrates the mean monthly BOD and SS concentrations in Sumner STP effluent from September, 1980, to September, 1982. It is apparent from Figure 2 that Sumner STP has been out of compliance with effluent limits since late 1981.

Sumner STP personnel report that effluent quality at the plant improves rapidly when discharges from the yeast plant are decreased (for instance, on weekends or holidays). This, in addition to the coincidental timing between lagoon startup, cessation of land disposal, and effluent disposal/pretreatment practices at the yeast plant, provides the circumstantial evidence that the yeast plant wastewaters are somehow linked to effluent deterioration at the Sumner STP.

A solution to this problem depends on accurately determining the cause/effect relationship (if any) between yeast plant wastewater characteristics and Sumner STP effluent quality. We were asked to aid in this effort and this memorandum summarizes the results of a reconnaissance and sampling survey conducted on November 18, 1982.

Survey Description

The Sumner STP and Nabisco Brands facilities were visited on November 18 1982, by Bill Yake, Ken Mauermann, and Frank Monahan. Portions of 24-hour composite samples of yeast plant lagoon effluent and Sumner STP influent and effluent were obtained from Hal Stahlhut (Sumner STP head operator). These samples were obtained by yeast plant and Sumner STP personnel and were composites for the time period of 8:00 a.m. November 17 to 8:00 a.m. November 18, 1982. In addition, grab samples of lagoon effluent and Sumner STP influent were obtained and several field tests (pH, D.O., temperature) conducted.

This survey was timed to coincide with maximum production at the yeast plant. Yeast plant personnel confirmed that the plant was running at the highest production of the year during the week of the survey. Lagoon effluent loads for BOD (1410 lbs/day) and SS (1460 lbs/day) recorded for the November 17-18 sampling period are higher than any of the monthly average loadings noted on Figure 1.

From the dark brown color of lagoon effluent and Sumner STP wastewaters, it was apparent that the yeast plant discharge contained substantial amounts of molasses.

The analytical results for each of the above-mentioned samples are tabulated in Table 1. Table 2 summarizes Sumner STP laboratory results for the same samples.

Table 2. Sumner STP laboratory test results.

	Nabisco Brands Lagoon Effluent Composite	Sumner STP Influent Composite	Sumner STP Effluent Composite
BOD_5 (mg/L)	847	388	128
TSS (mg/L)		532	94

Agreement between WDOE and Sumner laboratory results is marginal. The reasons for this are not known, but both sets of data indicate a heavy BOD and SS loading to the Sumner STP with violations of SS and BOD_5 effluent limits. WDOE data indicate that the yeast plant was contributing 28 percent of the BOD load and 36 percent of the SS load to the Sumner STP.

Table 3 summarizes the results of an analysis of the Sumner STP sludge for metals and compares these concentrations to those found in other Washington State treatment plants. It is apparent that metals concentrations in the Sumner sludge are typical and there is no indication that metals are responsible for any of the difficulties experienced at the plant.

Table 3. Metals concentrations in Sumner STP sludge (mg/kg d.w.).

Metal	Concentration in Sumner STP Sludge	Concentrations in 12-16 Digested Sludges from Activated Sludge Plants	
		Geometric Mean	Geometric Mean ± 1 S.D.
Cd	3.6	6.9	1.7- 28
Cr	23	81	42 - 155
Cu	390	326	173 - 612
Ni	20	18	2.7- 115
Pb	180	238	109 - 519
Zn	1400	1200	615 -2350

The potential for nutrient deficiency was present during the sampling period. The influent BOD:N:P ratio was 100:2.1:1.8 (if total phosphate-P is used) or 100:2.1:0.2 (if only orthophosphate-P is used). A generally accepted minimum ratio of 100:5:1 should be maintained to assure adequate N and P for the growth of micro-organisms (biomass) in secondary

treatment plants (WPCF, 1977). Nutrient deficiency was not observed during a sampling inspection conducted in 1978 (Yake and Morhous, 1978).

Although no lagoon influent sample was obtained at the yeast plant, BOD and nutrient results from the effluent samples indicate an even more severe nutrient deficiency in this waste stream.

Symptoms usually associated with nutrient deficiency usually include a poor settling sludge with high populations of filimentous organisms. Solids in the lagoon effluent and mixed liquor suspended solids (MLSS) at the Sumner plant both exhibit poor settling characteristics, but microscopic evaluation of these solids both during this survey and previously (Hal Stahlhut, Sumner STP operator, personal communication) has not displayed excessive filimentous growth.

Although MLSS at the Sumner STP generally settles poorly (SVIs of greater than 300 are not uncommon), bulking (visible loss of biomass over secondary clarifier overflow weirs) is uncommon. This did occur, however, during the week of November 18, two weeks after this inspection. Heavy BOD loads from the yeast plant lagoon were present for at least two weeks prior to bulking and nutrient deficiency may well have played a part in this plant upset.

Although acute incidences of visible bulking do occur, the chronic problem with permit compliance is more subtle. Effluent suspended solids concentrations will run in the 40 to 100 mg/L range for extended periods of time, although the sludge blanket appears to remain below the secondary clarifier weirs. This condition was observed during the November 18 survey. At this time the depth of the sludge blanket could not be determined due to the high amounts of color in the effluent. No floating sludge was observed and solids were not readily visible in the final effluent.

To characterize the type of suspended solids present in the final effluent, an aliquot of effluent was filtered through a smooth, 0.45 micron pore size filter. The solids collected by the filter were transferred to a glass slide, wetted, and covered with a cover slip. Microscopic examination (1,000 x) revealed that the solids were almost entirely (possibly 90 percent) small, spherical or slightly ovoid cells. These cells appeared to be similar to cells present in the third separator beer sample obtained at Nabisco Brands yeast plant. Although these cells were initially believed to be yeast cells, further discussions with Bill McKuen (Nabisco laboratory) revealed that the small size of these cells (clearly visible only at 1,000 x power) makes it more likely that they were bacteria (possibly *Diplococcus*).

This is the first time a microscopic evaluation of Sumner STP effluent solids has been done. It is, therefore, not known if the chronic effluent solids problem at Sumner is generally associated with these

homogeneous cells. Repeated observations during periods of permit violation would clarify this. Tentative arrangements between Hal Stahlhut and Bill McKuen have been made to accomplish this.

If the effluent TSS problem is generally associated with these cells, it may be that the lagoon at the yeast plant generates a large enough quantity of these cells to prevent compliance at the Sumner plant. Thus the loading of these cells to the Sumner STP may now be greater than it was prior to lagoon operation. Increased concentrations of these poor-settling cells may be responsible for the non-compliance problems at Sumner. The type of micro-organism community present in lagoon effluent is a function of many variables including viable organism populations in the lagoon influent, detention time (approximately equivalent to mean cell residence time or sludge age), and nutrient concentrations. Increases in nutrient concentrations or the addition of a clarifier with sludge return and wasting capabilities, might be used to alter the settling characteristics of the lagoon effluent and/or control the excessive growth of poor-settling solids.

Recommendations

We recommend that regular microscopic evaluation of Sumner STP effluent suspended solids be conducted. Results from these evaluations should determine if the presence of homogeneous populations of small, spherical/ovoid cells in the effluent is generally associated with the STP's effluent violations.

In cooperation with Nabisco Brands, these cells might be tested to identify them.

If excessive concentrations of these cells are implicated as the source of the problem, methods of reducing their concentrations in the yeast plant lagoon should be explored.

BY:cp

Attachments

REFERENCES

WPCF/ASCE, 1977. *Wastewater Treatment Plant Design, Manual of Practice 8.* Lancaster Press, Inc., 560 pp.

Yake, B. and M. Morhous, 1978. *Summer STP, Class II Inspection.* Memorandum to Ron Robinson, 8 pp.

Table 1. WDOE analytical results, Nabisco and Sumner STP wastewater samples.

	Nabisco			Sumner STP		
Sample Location	Third Separator Beer	Lagoon	Effluent	Influent		Chlorinated Effluent
Sample Type	Grab	Composite	Grab	Composite	Grab	Composite
Date	Nov. 18	Nov. 17-18	Nov. 18	Nov. 17-18	Nov. 18	Nov. 17-18
Time	1448	0800-0800	1500	0800-0800	1100	0800-0800
Flow (MGD)	--	.134	--	1.35	--	1.35
BOD_5 (mg/L)	81	1250	1250	450	--	100
T. Susp. Solids (mg/L)	22	1300	1350	365	160	44
COD (mg/L)	172	2500	2150	1250	990	340
NH_3-N (mg/L)	0.60	2.1	0.80	9.4	8.1	5.5
NO_2-N (mg/L)	<.10	0.40	0.30	0.10	0.10	0.20
NO_3-N (mg/L)	0.20	<.10	<.10	<.10	<.10	0.80
O-PO_4-P (mg/L)	0.20	2.1	1.7	0.90	1.2	0.20
T-PO_4-P (mg/L)	0.90	10.3	7.0	8.15	6.3	2.1
Total Solids (mg/L)	830	--	2980	1500	--	840
T. Non-Vol. Solids (mg/L)	655	--	1360	700	--	581
T. Susp. Solids (mg/L)	22	1300	1350	365	160	44
TNVSS (mg/L)	<1	--	300	<1	--	<1
Turbidity (JTU)	26	270	260	146	181	28
pH (S.U.)	7.4	7.1	7.1 7.4*	7.3	7.1 7.4*	7.6 7.4*
Spec. Cond. (µmhos/cm)	360	2490	2080	1200	1000	1070
Temperature (°C)			15.3*		15.5*	14.5*
Dissolved O_2 (mg/L)			1.0*		1.6*	0.6*

*Field analysis.

FIGURE 1. STD BRANDS EFFLUENT

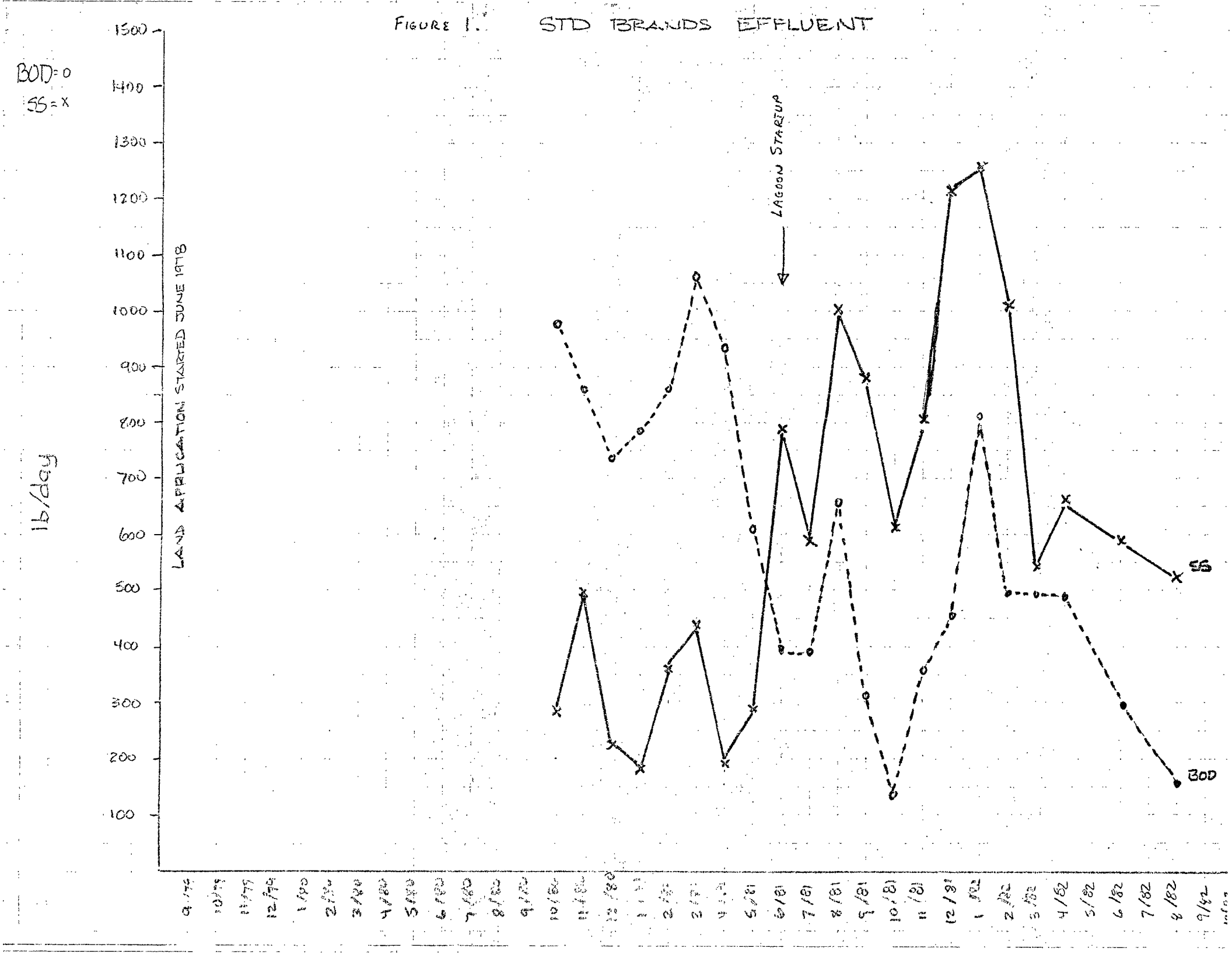

FIGURE 2: SUMNER STP:
MONTHLY AVERAGE EFFLUENT BOD_5 AND TSS CONCENTRATIONS (mg/l)